USE OF TECHNOLOGY TO CLOSE STATISTICAL KNOWLEDGE GAP

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Organizations are increasingly seeking to be data driven. This led to an evolving demand for quantitative skills in disciplines not traditionally perceived as quantitative in nature. Subsequently teachers are finding themselves faced with the challenge of teaching complex statistical concepts to student with limited background in mathematics. Teachers and instructors are also faced with the challenge of cross disciplinary classrooms where students have varied statistical knowledge. Use of technology can shorten statistics learning curve for students with limited background in mathematics. This paper looks at the impact of incorporation technology in teaching statistics in a cross disciplinary classroom. It seeks to determine how much of the gap in statistical knowledge was bridged by use of technology.

INTRODUCTION

With the phenomenal growth in the ICT industry over the last few years, the world today prioritizes availability of statistical information, statistical skills and statistical knowledge. Enhancing statistical literacy of our future generations is critical. Developing statistical reasoning of students consists of incorporating active learning strategies complement the theories learnt in class. Data collection and analysis is the heart of statistical thinking. Despite the widespread emphasis on reform in the teaching of Statistics and the increase in papers on Statistics education in the research literature, Statistics is still viewed as a discipline with a need for significant improvement in how students are educated (Garfield and Ben- Zvi, 2008).

In Kenya technology is yet to be fully integrated into teaching statistics. Opportunities of adopting technology include use of computing software and web technology to collect analyse and report data. At the university level adoption of technology is different at different institutions. Employers generally perceive students from some universities as more techno survey than students from public universities.

United States International University –USIU Kenya puts a lot of emphasis in preparing students for the work place. The approach to teaching is geared towards giving students the right knowledge and skills for the modern workplace. Programs are reviewed every five years for alignment with ever changing trends and skill requirements for the very dynamic work environment. Views of the Alumni, employers of the alumni, current students, potential employers and other relevant stakeholders are incorporated in the process of program review. The programs are generally well aligned to the requirements of the job market and graduates of the universities are attractive to employers.

This is a case study of student enrolled in a statistical research methods course at USIU. The students were varied in their background in mathematics as well as their level of day to day use of mathematical / statistical computing tools at work

This paper looks at the how realization of the learning outcomes were enhanced by use of technology in teaching a Masters level statistical research methods course. It also demonstrates how exposure to statistical computing tools at work enhances the learning experience.

TEACHING STATISTICS TO STUDENTS WITH A VARIED BACKGROUND IN MATHEMATICS

Background

Data plays a critical role in virtually all enterprises today and has become one of the most important and guarded asset for research, planning and decision making. As the world moves towards being data driven it is necessary for enterprises to improve the data literacy of to enable employees understand the usefulness of data and build the capacity to collect, analyse, interpret and draw conclusions from data for decision making. Kenya today prioritizes availability of statistical information, statistical skills and statistical knowledge. This has led to a marked growth in student's enrollment in Statistics courses at the universities and other tertiary institutions.

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Generally all courses and programs in most universities in Kenya have a compulsory statistics or mathematics unit. There is also a lot of pressure for employees to acquire statistical skills given that work places are increasingly becoming data driven, with data playing a critical role in virtually all enterprises today. Students with limited background in mathematics are increasingly acquiring skills that enable them play roles that require making decisions based on data. Thus a typical statistics methods class will comprise of students with an extremely varied background in Mathematics as well as varied exposure to statistical computations at work. There is needed a relook on how statistics is taught. Incorporation of technology and use of real life experiments and projects in teaching statistics has been known to enhance realization of learning outcomes. The study collates students' performance in the unit with respect to;

- Background in mathematics
- Previous exposure to mathematical / statistical computing tools at work

Varied Background in Mathematics

It is widely recognized that statistics is one of the most important quantitative subjects in a university curriculum (Watson, 1997). Teaching statistical courses to students with a varied back ground is challenging because students have varying abilities and attitudes.

Students enrolled for the statistical research methods course at USIU had a varied back ground in mathematics as evidenced by their undergraduate courses of study. Students with undergraduate degrees in business and natural science courses such as Commerce, Statistics, Engineering and Medicine comprised of 53% of the course enrollment and these were considered to have a strong background in Mathematics. Students with humanities and social sciences degrees such as Journalism, Law, Sociology and Hospitality, who comprised of 47% were considered not have not a very strong background in Mathematics.

Previous Exposure to Mathematical / Statistical Computing tools at Work

The study also looked at how much students had been exposed to statistical computations and applications at work, as evidenced by their job titles. This being an MBA Class, the students were drawn from very varied professionals. Professions that were considered as having given students exposure to statistical computations include Accountancy, Analysis, Engineering, Finance, and Project Management, who comprised 55% of the students. 40% were engaged in roles that gave them limited exposure to statistical computing skills such as Sociology, Creative Arts, Human Resources Management and Public Administration. 5 % were not working.

USING TECHNOLOGY TO TEACH STATISTICS

The Course Outline

This is a course of statistical methods as applied in Business administration. The course explores the process of transforming data into information through data entry, management and analysis, as well as reporting the research findings. It prepares the students for their research projects which is done in the next semester. Specifically this course looks at statistics as a decision making tool in organizations' and links between statistics and research strategies. Applications of descriptive statistics and ideas of statistical inference Point and interval estimation, Confidence intervals, testing of hypotheses, Calculation of type I and type II errors, Determination are introduced. Basic ideas about sampling distributions with particular reference to chi-square, t and F distributions of sample size. The course ends with a lesson on reporting research. The entire course is taught in a computing laboratory with introduction of statistical software such as SPSS and R as a tool for statistical methods done in week 2. The lessons are designed such that every new concept taught has a computing component that gives the students the opportunity use real data for application of concepts and knowledge.

Incorporating Technology in teaching Statistics

Opportunities of adopting technology to enhance teaching statistics include use of computing tools, web technology and e-learning. Data collection and analysis is the heart of statistical thinking. Data collection promotes learning by experience and links the learning process to reality (Snee, 1993). From week 2 when the application of statistical software is done the students had an

opportunity to try out working with real data using SPSS and Excel. A few students preferred to use other software. It was necessary to allow students to use the software they were comfortable with, while encouraging them to learn at least one additional advanced analytics tool. Data collected from previous studies was stored in a data base for use as a resource during the lessons.. For every new concept introduced, basic principles, theories and concepts would be discussed. The students would then be guided on how to use the statistical software for application of the theories and concept learned. Throughout the course the student would have an experience in data collection, entry, descriptive and inferential analysis. There was an emphasis on how to report the findings.

Use of computing tools created a lot of interest and enthusiasm among the learners. Ability to perform simple regression, graphically represent, interpret and correctly report findings was especially very exciting moment for students with limited background in statistics. Student attitude towards the course improved week by week.

Use of Real Life Experiments

Teaching statistics should emphasize the understanding of statistical concepts and methods in a concrete way that students are able to precisely apply statistical skills to solving real live problems. This kind of data invites considerations about the nature and quality of the data collection process and implications concerning validity and reliability of measurement instruments like questionnaires. Students come to understand that such information is meaningful in statistical analysis as it provides crucial background material. They become aware that data do not exist in a vacuum, but that there is a story behind the numbers; students learn that statistical analysis involves developing the "narrative "of the data, "unlocking the stories in the data" (Garfield & Ben-Zvi, 2007, pp. 19). Students should be able to identify opportunities to leverage on the most recent and modern computational skills and tools. Generally, the goal of statistics education is to answer 'real world' questions. Part of the course work was a student's project. This was a group assignment designed to run for the whole semester. With students working in small groups of 5-7. Each group conducted a research project which culminated with the research findings being presented in the last lesson of the semester. The class project entailed choosing a research topic with clear objectives, data collection and analysis. The projects would be periodically reviewed. Students were encouraged to use digital methods of data collection such as web surveys and data mining, where applicable.

The project was an excellent opportunity for students to apply the theories and the computing skills learnt in class to real life situation of interest. It was also an opportunity for them to experience collection of data. This enhanced realization of the learning outcome

LEARNING OUTCOMES

General Performance

Despite the fact that about half of the students didn't have a good background in statistics, the general performance of the class in this unit was good. Students also gave their feedback that they felt they could more effectively handle roles and tasks that required them to make decisions based on data. Students performing roles previously viewed as not requiring data said that that they were now able to identify opportunities to use data for enhanced efficiency and insightful decision making in their day to day work.

Students' performance was a summation of their term paper, projects and written exams. A collation between performance with background in mathematics and previous exposure in working with computing software was done. Performance was measured by the grades scored at the end of the semester. For this study performance ranged from excellent, very good, good, fair and fail. Background in Mathematics was classified as either strong (2) or not strong (1). Previous exposure to working with computing software was classified as either strong (2) or not strong(1)

Performance and Background in Mathematics

Technology enhances learning of statistics beyond having a strong background in mathematics. All students seemed to have a good understanding of statistical concepts and were able to effectively

identify opportunities to apply the theories and concepts to real life situations. This was irrespective of their varied background in Mathematics. Among the students with a strong background in mathematics, 55% recorded a score of at least "Very Good" . On the other hand 50% of those with a not very strong background in mathematics had a score of at least "Very Good". A chi square test concluded that there was no significant difference in performance of the two groups of students classified according to the strength of their mathematical background.
It is evident use of technology closes the statistical and mathematical literacy gap. Student with limited previous exposure to mathematical are able to grasp and apply complex statistical concepts if interest in the subject is created and the right approach to leaning is applied.

Performance and Previous exposure to use of statistical computing software
Day to day exposure to use of statistical computing software significantly enhances the students' ability to grasp and apply statistical concept and theories. It is easy to introduce new and complex statistical concepts and theories and more advanced analytics to students who are already using data and statistical tools every. This being an MBA class 95% of the students were already working. 55% of the students were enrolled in roles that required computing. Among them 66% scored a grade of at least 'Very Good'. 33% of learners whose work role didn't require day to day use of software scored a grade of at least 'Very Good' while 50% scored 'good'. A chi square test concluded that there was a significant difference in performance of the two groups of students classified by their previous exposure to statistical computing. Thus students with a previous exposure to statistical computing are more likely realize better performance.

CONCLUSION

Institutions of learning need to align statistical education to the current and future needs of the market. Given the current emphasis on statistical knowledge in Kenya, there is need to review the scope of Statistics education curriculum in Kenya and align it to trends and requirements of the industry. There is need to adopt teaching methods and technologies that create interest among learners. Technology should be adopted as much as possible at all levels of Statistics education Organizations need to challenge employees to use data for day to day decision making. This will enhance their statistical computing skills and their statistical knowledge. There is need to build employees capacity to learn and apply more complex statistical concepts as enterprise moves towards being data driven Continuous environmental scans that identify new trends and technologies should be mainstreamed in education management. The curriculum developers need to ensure leverage on emerging technologies and inclusion of views from the industry players in curriculum review process.

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